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Effect of Conduction Mode and Location on Electrophysiologic Characteristics of Accessory Pathways

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The conduction properties of accessory pathways (APs) are independent of location and conduction mode (except in patients with multiple, Mahaim, and slowly conducting APs). Patients with right-sided APs show higher rates of atrial fibrillation and longer arrhythmia cycle length due to slower anterograde conduction over the atrioventricular node during atrioventricular reentrant tachycardia. ©2005 by Excerpta Medica Inc.

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The objective of this study was to determine the arrhythmia characteristics and electrophysiologic properties of accessory pathways (APs) with respect to their location and conduction mode (bidirectional vs concealed) in patients with single APs. Because most previous studies have assessed the influence of AP location on electrophysiologic properties, such as decremental and slow anterograde and/or retrograde conduction,[1–8] we excluded such patients (i.e., those with Mahaim and slowly conducting APs) from our study.

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From March 2002 to March 2004, 136 consecutive symptomatic patients with single APs (overt or concealed) who underwent radiofrequency catheter ablation were included in this study. All patients gave written informed consent for electrophysiologic study and ablation. The study was approved by our institutional review committee. Eighty-three of the patients were men (61%) (mean age 33.6 ± 13.5 years). Structural heart disease was present in 8 patients (5.9%; 4 with mitral valve prolapse, 2 with Ebstein's anomaly, and 2 with valvular heart disease). The presenting symptoms were palpitation, dizziness, syncope and/or presyncope, and chest pain in 113, 10, 10, and 3 patients, respectively. The sudden onset and offset of symptoms were noticed in 97 patients (71.3%) and 93 patients (68.4%), respectively. The mean duration of symptoms before catheter ablation was 6 ± 5 years.

All antiarrhythmic medications were withdrawn before the electrophysiologic study for 5 half-lives. Three 6Fr quadripolar catheters (DAIG, St. Jude Medical, Inc., St. Paul, Minnesota) were introduced through the femoral veins and positioned at the right ventricular apex, the His bundle, and the high right atrium. A 7Fr steerable decapolar catheter (Marinr, Medtronic, Inc., Minneapolis, Minnesota) was introduced through the right femoral vein and positioned in the coronary sinus. Twelve-lead surface electrocardiograms and bipolar filtered (30 to 500 Hz) and unipolar unfiltered electrograms were recorded, displayed, and stored on an electrophysiologic recording system (EPMed Systems, Inc., West Berlin, New Jersey). Mapping was done during sinus rhythm and arrhythmia. The locations of APs were determined on the basis of standard fluoroscopic views (Figure 1).[6] The presence of dual atrioventricular nodal physiology and concomitant arrhythmias was assessed. The anterograde and retrograde effective refractory periods (ERPs) of APs, the mode of conduction, and the arrhythmia cycle length were measured. An Atakr II (Medtronic, Inc.) radiofrequency energy generator (486 kHz) was used for radiofrequency catheter ablation.

We defined the anterograde ERP of an AP as the longest atrial extrastimulus coupling interval that

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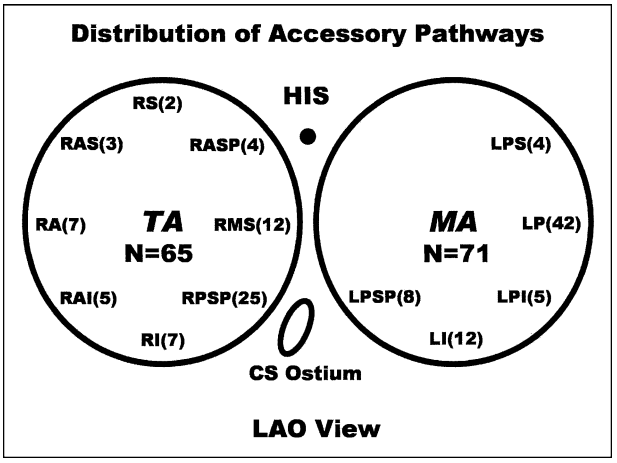

FIGURE 1. Representation of AP distribution along the left and right atrioventricular grooves in the left anterior oblique (LAO) view. CS = coronary sinus; LI = left inferior; LP = left posterior; LPI = left posteroinferior; LPS = left posterosuperior; LPSP = left paraseptal; MA = mitral annulus; RA = right anterior; RAS = right anterosuperior; RASP = right anteroseptal; RI = right inferior; RMS = right midseptal; RPSP = right paraseptal; RS = right superior; TA = tricuspid annulus.

failed to conduct over the AP (absence of ventricular preexcitation), the retrograde ERP of an AP as the longest ventricular extrastimulus coupling interval that failed to conduct in a retrograde manner over the AP, and dual atrioventricular nodal physiology as a ≥50-ms increase in the atrium–His bundle (AH) interval during programmed atrial stimulation in response to a 10-ms decrease in the atrial extrastimulus coupling interval.

Variables are expressed as mean ± SD and percentage. Differences in characteristics between 2 groups were assessed by the independent-samples Student's *t* test for continuous variables and the chi-square test (or Fisher's exact test if necessary) for discrete variables. A 2-tailed p value <0.05 was considered significant.

During the study, 168 patients with APs were studied and underwent radiofrequency catheter ablation at our center. Of these, 146 (87%) had single APs and 22 (13%) had multiple APs. In the former group, we further excluded 10 patients with Mahaim (n = 8) or slowly conducting (n = 2) APs. We included the remaining 136 patients in our final analysis. Of these, 112 patients (82%) had bidirectional APs, and 24 patients (18%) had concealed APs. Seventy-one patients (52%) had left-sided APs, and the remaining 65 patients (48%) had right-sided APs. Septal and free-wall APs were observed in 49 patients (36%) and 87 patients (64%), respectively (Figure 1).

Orthodromic and antidromic atrioventricular reentrant tachycardia (AVRT) were induced during programmed electrical stimulation in 100 patients (73.5%) and 3 patients (2.5%), respectively. The arrhythmia cycle length was 335 ± 56 ms. Arrhythmia other than AVRT was observed in 25 patients (atrioventricular nodal reentrant tachycardia in 2 [1.5%] and atrial fibrillation in 23 [17%]). Dual atrioventricular nodal physiology was observed in 33 patients (24%).

Table 1 lists electrophysiologic findings on the basis of AP location and mode of conduction. Anterograde and retrograde ERPs of APs, gender distribution, and the conduction modes of APs were comparable between different locations. Patients with right-sided APs had longer arrhythmia cycle lengths and higher rates of atrial fibrillation. The prevalence of dual atrioventricular nodal physiology was comparable among all locations and conduction modes of AP. In patients with right- and left-sided APs, the AH intervals during sinus rhythm were 80 ± 16 and 85 ± 21 ms, respectively (p = 0.305). During arrhythmia, the AH intervals in patients with right- and left-sided APs were 196 ± 34 and 155 ± 40 ms, respectively ($p < 0.001$).

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In patients with single APs (excluding Mahaim and slowly conducting APs), conduction properties did not depend on the locations and conduction modes of APs. The prevalence of dual atrioventricular nodal physiology was comparable among all locations and conduction modes of AP. Patients with right-sided APs had longer arrhythmia cycle lengths and higher rates of atrial fibrillation.

Previous studies have shown that the location of an AP influences some of its electrophysiologic properties (i.e., decremental and/or slow conduction).[8] However, our data showed that the conduction properties of APs (excluding those with decremental and/or slow conduction) are not affected by their location and/or conduction modes. De Chillou et al[8] suggested that in patients with left free-wall APs, symptoms occur later in life compared with those with other APs. However, our findings did not show such a trend. The ages at presentation were 34.6 ± 13 and 33.4 ± 13.7 years in patients with left free-wall versus other APs, respectively (p = 0.62). The duration of symptoms in the 2 groups was also comparable (5.6 ± 4.8 vs 6.8 ± 5.2 years, p = 0.17).

Contrary to previous studies,[1] the rate of inducible AVRT during the electrophysiologic study was comparable in patients with (55.6%) and without (76.5%) atrial fibrillation (p = 0.34), and inducible atrial fibrillation during electrophysiologic study was more prevalent in patients with concealed APs. These variations may be explained by different electrophysiologic protocols and patient populations.

We found that arrhythmia cycle lengths were longer in patients with right-sided APs compared with the rest of the patients. Because the retrograde ERP in left- and right-sided APs was comparable (Table 1), we postulated that the difference might be due to slower anterograde atrioventricular nodal conduction. Our findings supported our assumption and showed that in AVRTs incorporating right-sided APs, the AH interval was longer than those incorporating left-sided APs. Liu et al[5] also recently showed that in patients with right free-wall APs, the anterograde conduction over the atrioventricular node is slower compared with those with other AP locations.

TABLE 1 Electrophysiologic Findings Based on AP Location and Mode of Conduction

	Septal vs Free Wall			Left vs Right			Overt vs Concealed		
Variable	Septal	Free Wall	p Value	Left	Right	p Value	Overt	Concealed	p Value
Anterograde ERP (ms)	291 ± 84	292 ± 80	0.96	288 ± 81	295 ± 83	0.69	—	—	—
Retrograde ERP (ms)	291 ± 56	303 ± 58	0.34	306 ± 59	290 ± 54	0.22	304 ± 52	297 ± 58	0.66
Arrhythmia cycle length (ms)	347 ± 58	330 ± 54	0.15	322 ± 55	352 ± 55	0.045*	339 ± 40	336 ± 59	0.84
Atrial fibrillation (n, %)	12	11	0.35	6	17	0.028*	14 (12.5%)	9 (37.5%)	0.037*
Men/women (n)	29/20	55/32	0.24	46/25	38/27	0.30	67/45	17/7	0.36
Dual atrioventricular nodal physiology (%)	25%	22%	0.41	20%	25%	0.33	22%	25%	0.47
Concealed (%)	23%	15%	0.251	16%	20%	0.65	—	—	—
Inducible AVRT (%)	74%	73%	0.728	74%	72%	0.477	68%	73%	0.630

*p value (2-tailed) <0.05 was considered significant.

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Comparison of Clinical Presentation of Acute Myocarditis Following Smallpox Vaccination to Acute Coronary Syndromes in Patients <40 Years of Age*

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Smallpox vaccine–associated myopericarditis may have a similar presentation to acute coronary syndrome (ACS). The clinical records of 78 young patients (<40 years of age) presenting with ACS (n = 16) or myocarditis after smallpox vaccination (n = 62) were reviewed. Comparisons were made among clinical presentation, cardiac enzymes, echocardiographic findings, and electrocardiographic changes. The presence of cardiac risk factors or focal wall motion abnormalities on echocardiography were associated with a diagnosis of ACS. There was a trend toward earlier elevation of troponin-I and creatine kinase in patients with myocarditis compared with ACS. ©2005 by Excerpta Medica Inc.

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Chest pain is a frequent complaint in young patients seeking medical attention. Even after initial evaluation with histories and physical and laboratory studies, there is considerable clinical overlap between young patients with acute coronary syndrome (ACS) and those presenting with myocarditis.[1–4] Recent reports have described the greater than expected incidence of myopericarditis after smallpox vaccination in United States military personnel,[5–7] and all these patients were identified after presentation for chest symptoms. However, little information exists to differentiate these patients from those with premature atherosclerosis causing ACS. The purpose of this

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